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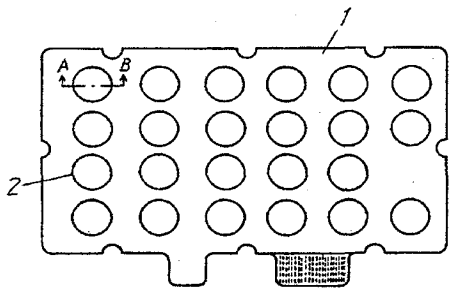
(54) EL SHEET DIAPHRAGM AND SWITCH USING THE SAME

(57) The present invention relates to a lighted switch used in input sections of various kinds of electronic devices, and a uniformly luminous EL sheet diaphragm and a lighted switch which is of a thin structure using the same are provided.

The uniformly luminous EL sheet diaphragm is formed by molding a diaphragm portion 2 in a diffusion-type EL sheet which comprises a transparent electrode layer 4 formed on a transparent film 3, a light emitting layer 5, a dielectric layer 6, a rear electrode layer 7 and an insulating layer 8 in such manner that a light emitting surface is in a convex side, and the switch is provided by an electrode contact layer 9 newly formed on the insulating layer 8 in a concave side of the EL sheet diaphragm and an opposed electrode contact layer 11 formed on an insulating film base 10 opposite thereto, so that the thin structure can be achieved.

Further, the transparent electrode layer 4 of the EL sheet diaphragm is formed by printing and drying a paste prepared by dispersing conductive powders that has a visible light transmittance in an insulating resin, and a high dielectric constant and flexible resin selected from vinylidene fluoride rubber and a blended resin of cyanated pullulan or cyanated cellulose and cyanated polyvinyl alcohol is employed as a binder resin for the light emitting layer 5 and dielectric layer 6, so that light emission failures due to wire breakage in the diaphragm portion 2 can be reduced, and a high quality EL sheet diaphragm and a switch using the same can be provided.

Fig. 1



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trode layer 7 and insulating layer 8.

To make the EL sheet, a diffusion-type light transmitting paste prepared by adding 65 wt. % of conductive powders having a visible light transmittance, that is, indium oxide powders (SCP-X prepared by Sumitomo Metal Mining) to an insulating resin (a flexible acrylated bisphenol resin, MRXA prepared by Meiwa Chemical Industry), and dispersing them using three rolls is screen-printed onto the PET film 3 of 125 μm thick, and dried at 155 °C for 15 min so that the transparent electrode layer 4 of 3 to 5 μm in dry film thickness is formed.

Then, the light emitting layer 5 is formed in a manner similar to that of forming the transparent electrode layer 4 by printing and drying a paste which is prepared by mixing and dispersing 0.02 g of gicumyl peroxide as a cross linking agent and 100 g of a light emitting element (TYPE 40 prepared by Silvania, U.S.A.) in a vinylidene fluoride copolymer rubber solution (Daiel G902 prepared by Daikin Industries and 35 wt. % of isophorone solved thereto) so that a dry film thickness of 35 μm is achieved.

Further, the dielectric layer 6 is formed in a similar manner by printing and drying a paste which is prepared by dispersing, using three rolls, 50 g of $BaTiO_3$ (prepared by Kanto Chemical Industry) in 28 g of a mixed solution of 70 wt. % of cyanoethyl pullulan resin and 30 wt. % of cyanoethyl polyvinyl alcohol resin (dimethyl formamide and 35 wt. % of CR-M prepared by Shin-Etsu Chemical that is solved thereto) so that a dry film thickness of 35 μm is achieved.

Thereafter, the rear electrode layer 7 is formed in a similar manner by printing and drying a conductive paste (DY-150H prepared by Toyobo) so that a dry film thickness of 10 μm is obtained.

Finally, the insulating layer 8 is formed similarly by printing and drying an insulating paste (XB-804A prepared by Fujikura Chemical Industry) so that a dry film thickness of 30 μm is achieved.

Next, an upper electrode contact 9 of specified dimensions and a dry film thickness of 8 μm is formed on the insulating layer 8 in a similar manner by drying a conductive paste (DW-250H prepared by Toyobo).

Then, the diaphragm portion 2 is formed by using a mold that is heated to 170 °C , and molding it to a dome shape so that it is convex in a side of the PET film 3.

Thereafter, a lower electrode contact 11 is formed by pattern-printing and drying a conductive paste (DW-250H prepared by Toyobo) onto a PET film 10 of 75 μm thick, and the switch 1 using the EL sheet diaphragm is completed by combining the diaphragm portion 2 and a lower electrode contact sheet that is prepared by pattern-printing and drying an insulating paste (XB-804A prepared by Fujikura Chemical Industry) as an insulating resist 12 by means of thermo compression bonding in such manner that the upper electrode contact 9 and lower electrode contact 11 of the diaphragm portion 2 are opposed to each other.

As shown in Fig. 3, the upper electrode contact 9 is pressure-connected at a connection part 9a thereof with an external lead pattern of the lower electrode contact sheet, and an electrode lead-out portion of the diaphragm 2 forms, as shown in Figs. 4 and 5, rear electrode layers 7, 7a of a conductive paste and a connecting electrode 4b on a light transmitting electrode 4a in order for better connection.

In the switch 1 using an EL sheet diaphragm according to the invention, as a result of observing a light emitting condition of EL by applying a power of 100 V 400 Hz to the connecting electrode 4b and rear electrode layer 7a, reversing the diaphragm portion 2 by pressing the diaphragm portion 2 with a finger from above, and repetitively connecting the upper electrode contact 9 and lower electrode contact 11 (switching operation), it was confirmed that a uniform light was emitted, a light emitted by EL was always uniform even when the switching operation is repeated 500,000 times, and a superior light emitting performance was achieved.

In the embodiment, an EL sheet diaphragm may be produced by respectively using, as a binder resin for the light emitting layer 5 and dielectric layer 6), a vinylidene fluoride copolymer rubber (Daiel G501 prepared by Daikin Industries), a mixed resin of 50 wt. % of cyanoethyl pullulan (CR-S prepared by Shin-Etsu Chemical) and 50 wt. % of cyanoethyl polyvinyl alcohol (CR-V prepared by Shin-Etsu Chemical) or a mixed rubber of 50 wt. % of cyanoethyl cellulose (prepared by Shin-Etsu Chemical) and 50 wt. % of cyanoethyl polyvinyl alcohol (CR-V prepared by Shin-Etsu Chemical), and setting the ratio between the light emitting element or dielectric element and the binder resin at the same ratio as that of the embodiment.

As described above, according to the embodiment, breakage of the ITO film during molding of the diaphragm portion 2 can be prevented, and a service life can be increased by printing and drying the paste (diffusion-type light transmitting paste) prepared by dispersing conductive powders that has a visible light transmittance in an insulating resin or a resin solution containing an insulating resin solved therein to form the transparent electrode layer 4, and breakage of a binder resin for the light emitting layer 5 and dielectric layer 6 can be avoided by using, as a binder resin for the light emitting layer 5 and dielectric layer 6, a resin having a high dielectric constant and flexibility, which is selected from a vinylidene fluoride rubber, vinylidene fluoride copolymer rubber, a resin prepared by blending cyanated pullulan and cyanated polyvinyl alcohol or a resin prepared by blending cyanated cellulose and cyanated polyvinyl alcohol.

By molding the diaphragm portion 2 such that clicking is sensed in response to a compressive force, an operational feeling of the switch can be provided, and the diaphragm portion 2 can be molded either by heating the EL sheet to 70 °C to 180 °C or heating the mold to 70 °C to 180 °C , so that breakage of the ITO film

Thus, according to above constitution, a high quality, superior EL sheet diaphragm capable of achieving uniform lighting, lower power consumption, good operational feeling and reduced light emission failure and a thin, light-weight switch using the same can be provided.

LIST OF REFERENCE NUMERALS IN THE DRAWINGS

1	Switch using an EL sheet diaphragm
2, 2a, 2b, 2c	Diaphragm portion
3	PET film
4	Transparent electrode layer
4a	Light transmitting electrode
4b	Connecting electrode
5	Light emitting layer
6	Dielectric layer
7, 7a	Rear electrode layer
8	Insulating layer
9	Upper electrode contact
9a	Connecting part
10	PET film
11	Lower electrode contact
12	Insulating resist
13	Switch using an EL sheet diaphragm of multicolor light emission type

Claims

1. An EL sheet diaphragm comprising a diffusion-type EL sheet which includes a transparent electrode layer formed on a transparent film, a light emitting layer, a dielectric layer, a rear electrode layer and an insulating layer, is formed with a diaphragm portion molded in a dome shape with a flange-like supporting portion in an outer circumference thereof such that a light emitting surface is in a convex side, and is reversed with or without a feeling of moderation when it is pressed for operation, and is provided with a lighting area in an entire surface thereof, only in said diaphragm portion or said diaphragm portion and the vicinity thereof.

2. An EL sheet diaphragm of claim 1, wherein said transparent electrode layer is formed by printing and drying a paste which is prepared by dispersing conductive powders that has a visible light transmittance in an insulating resin or a resin solution containing an insulating resin solved therein.

3. An EL sheet diaphragm of claim 1, wherein a binder resin used for said light emitting layer and dielectric layer is selected from a vinylidene fluoride rubber, vinylidene fluoride copolymer rubber, a resin prepared by blending cyanated pullulan and cyanated polyvinyl alcohol or a resin prepared by blending cyanated cellulose and cyanated polyvinyl alcohol.

4. An EL sheet diaphragm of claim 2, wherein a binder resin used for said light emitting layer and dielectric layer is selected from vinylidene fluoride rubber, vinylidene fluoride copolymer rubber, a resin prepared by blending cyanated pullulan and cyanated polyvinyl alcohol or a resin prepared by blending cyanated cellulose and cyanated polyvinyl alcohol.

5. A switch using an EL sheet diaphragm of claim 1, wherein a membrane switch having an opposed electrode contact is provided below said EL sheet diaphragm, or an electrode contact layer is newly formed on said insulating layer in a concave side of said EL sheet diaphragm, and an opposed electrode contact layer is formed on an insulating film base or insulating resist base opposite thereto.

6. A switch using an EL sheet diaphragm of claim 2, wherein a membrane switch having an opposed electrode contact is provided below said EL sheet diaphragm, or an electrode contact layer is newly formed on said insulating layer in a concave side of said EL sheet diaphragm, and an opposed electrode contact layer is formed on an insulating film base or insulating resist base opposite thereto.

7. A switch using an EL sheet diaphragm of claim 3, wherein a membrane switch having an opposed electrode contact is provided below said EL sheet diaphragm, or an electrode contact layer is newly formed on said insulating layer in a concave side of said EL sheet diaphragm, and an opposed electrode contact layer is formed on an insulating film base or insulating resist base opposite thereto.

8. A switch using an EL sheet diaphragm of claim 4, wherein a membrane switch having an opposed electrode contact is provided below said EL sheet diaphragm, or an electrode contact layer is newly formed on said insulating layer in a concave side of said EL sheet diaphragm, and an opposed electrode contact layer is formed on an insulating film base or insulating resist base opposite thereto.

9. An EL sheet diaphragm of claim 1, wherein said diaphragm portion is molded by heating said EL sheet which comprises said transparent film of polyethylene terephthalate to 70 to 180 °C , or heating a mold for said diaphragm portion to 70 to 180 °C.

10. An EL sheet diaphragm of claim 2, wherein said diaphragm portion is molded by heating said EL sheet which comprises said transparent film of polyethylene terephthalate to 70 to 180 °C, or heating a mold for said diaphragm portion to 70 to 180 °C.

11. An EL sheet diaphragm of claim 3, wherein said diaphragm portion is molded by heating said EL

phragm so that said color of light emitted by said EL sheet is entirely or partly changed.

26. An EL sheet diaphragm of claim 10, wherein single color or multiple, two or more, colors of light is emitted from said light emitting layer of said EL sheet, and said transparent film is colored, a color paint is applied to said transparent film, or a color film is placed on a convex surface of said EL sheet diaphragm so that said color of light emitted by said EL sheet is entirely or partly changed.

27. An EL sheet diaphragm of claim 11, wherein single color or multiple, two or more, colors of light is emitted from said light emitting layer of said EL sheet, and said transparent film is colored, a color paint is applied to said transparent film, or a color film is placed on a convex surface of said EL sheet diaphragm so that said color of light emitted by said EL sheet is entirely or partly changed.

28. An EL sheet diaphragm of claim 12, wherein single color or multiple, two or more, colors of light is emitted from said light emitting layer of said EL sheet, and said transparent film is colored, a color paint is applied to said transparent film, or a color film is placed on a convex surface of said EL sheet diaphragm so that said color of light emitted by said EL sheet is entirely or partly changed.

29. A switch using an EL sheet diaphragm of claim 13, wherein single color or multiple, two or more, colors of light is emitted from said light emitting layer of said EL sheet, and said transparent film is colored, a color paint is applied to said transparent film, or a color film is placed on a convex surface of said EL sheet diaphragm so that said color of light emitted by said EL sheet is entirely or partly changed.

30. A switch using an EL sheet diaphragm of claim 14, wherein single color or multiple, two or more, colors of light is emitted from said light emitting layer of said EL sheet, and said transparent film is colored, a color paint is applied to said transparent film, or a color film is placed on a convex surface of said EL sheet diaphragm so that said color of light emitted by said EL sheet is entirely or partly changed.

31. A switch using an EL sheet diaphragm of claim 15, wherein single color or multiple, two or more, colors of light is emitted from said light emitting layer of said EL sheet, and said transparent film is colored, a color paint is applied to said transparent film, or a color film is placed on a convex surface of said EL sheet diaphragm so that said color of light emitted by said EL sheet is entirely or partly changed.

32. A switch using an EL sheet diaphragm of claim 16, wherein single color or multiple, two or more, colors of light is emitted from said light emitting layer of said EL sheet, and said transparent film is colored, a color paint is applied to said transparent film, or a color film is placed on a convex surface of said EL sheet diaphragm so that said color of light emitted by said EL sheet is entirely or partly changed.

Amended claims under Art. 19.1 PCT

1. (AMENDED) An EL sheet diaphragm comprising a diffusion-type EL sheet which includes a transparent electrode layer formed on a transparent film, a light emitting layer, a dielectric layer, a rear electrode layer and an insulating layer is formed with a diaphragm portion molded in a dome shape with a flange-like supporting portion in an outer circumference thereof such that a light emitting surface is in a convex side, and is reversed with or without a feeling of moderation when it is pressed for operation, and is provided with a lighting area in an entire surface thereof, at least in said diaphragm portion only or an entire area of said diaphragm portion and the vicinity thereof.

Fig. 2

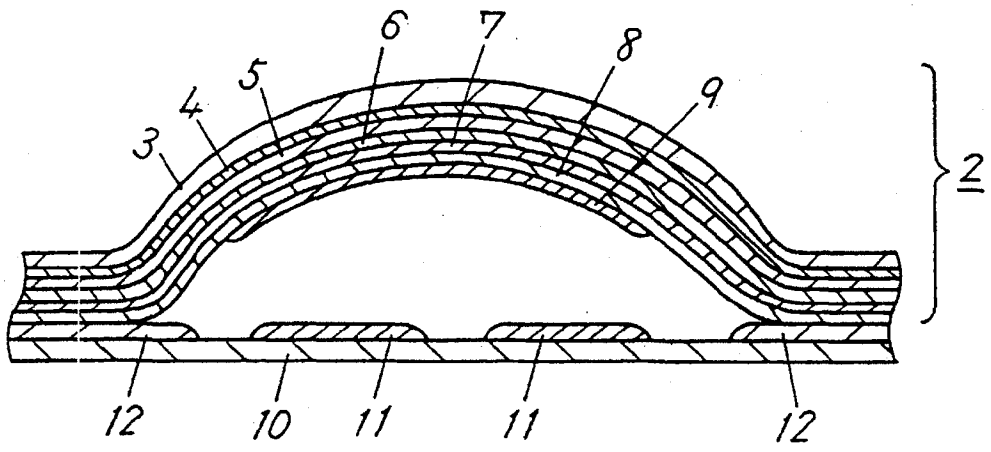


Fig. 4

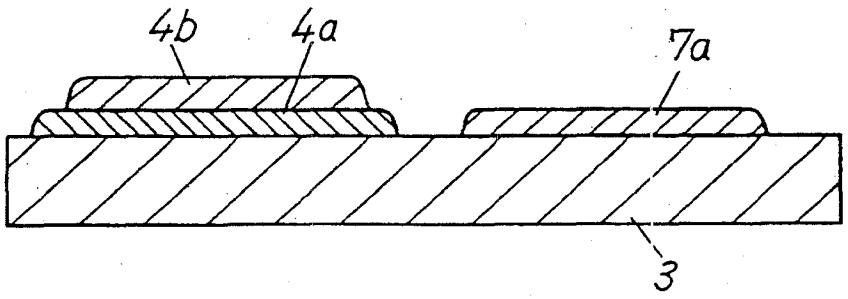


Fig. 6

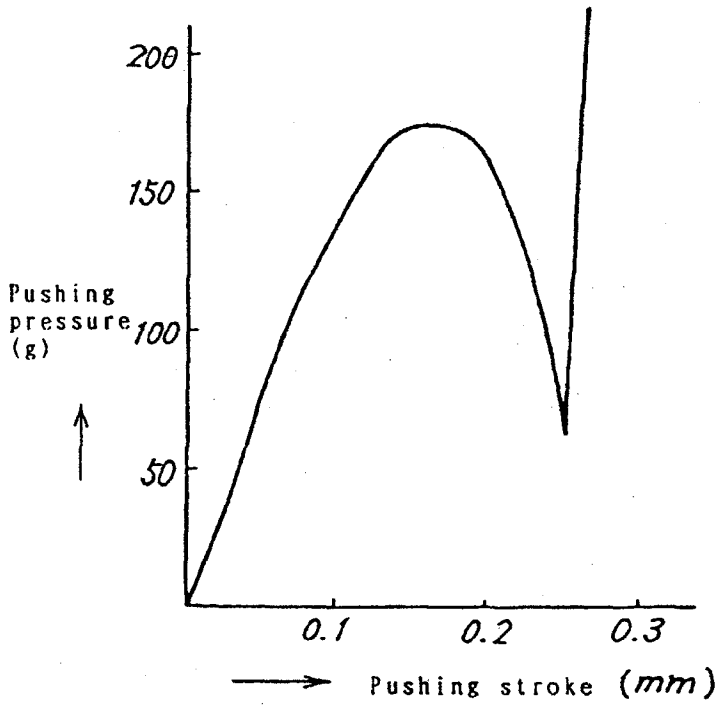
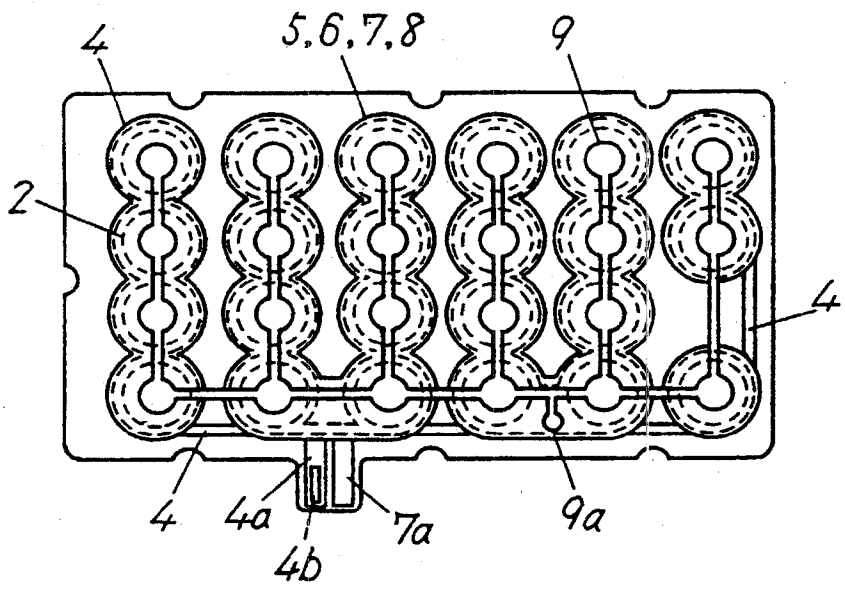


Fig. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP96/00831

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Fig. 4 (Family: none)	
Y	JP, 59-44723, A (Sanyo Electric Co., Ltd.), March 13, 1984 (13. 03. 84), Figs. 2, 3 (Family: none)	1 - 32

Form PCT/ISA/210 (continuation of second sheet) (July 1992)